

Claims:

1. A method of forming an SOI substrate having at least two exposed surface crystal orientations, said method comprising:

providing an SOI substrate having a first silicon layer with a surface having a first crystal orientation located on a first buried oxide layer, said buried oxide layer being located on a silicon substrate having a surface with a second crystal orientation;

selectively removing the first silicon layer and the first buried oxide layer from a first portion of the SOI substrate to expose a first surface portion of the silicon substrate;

epitaxially growing a second silicon layer over the first surface portion of the silicon substrate, said second silicon layer having a surface with a second crystal orientation; and

forming a second buried oxide layer in the second silicon layer.

2. The method of claim 1 wherein the selectively removing step comprises the steps of:

providing a hard mask over the first silicon layer;

providing a photoresist pattern on the hard mask; and

etching portions of the first silicon layer and the buried oxide layer not covered by said photoresist, and removing said photoresist.

3. The method of claim 2 wherein said hard mask comprises Si_3N_4 .

4. The method of claim 1 wherein the step of forming the second buried oxide layer comprises the steps of implanting oxygen ions into the second silicon layer and annealing the SOI substrate.

5. The method of claim 1 wherein the first crystal orientation is a (110) orientation and the second crystal orientation is a (100) orientation.

6. The method of claim 1 wherein the first crystal orientation is a (100) orientation and the second crystal orientation is a (110) orientation.
7. An SOI substrate constructed in accordance with the method of claim 1.
8. A method of forming a least two semiconductor devices on a common dual plane SOI substrate having at least two exposed surface crystal orientations, said method comprising:
 - A. fabricating the dual plane SOI substrate by:
 - i. providing an SOI substrate having a first silicon layer with a surface having a first crystal orientation located on a first buried oxide layer, said buried oxide layer being located on a silicon substrate having a surface with a second crystal orientation;
 - ii. selectively removing the first silicon layer and the first buried oxide layer from a first portion of the SOI substrate to expose a first surface portion of the silicon substrate;
 - iii. epitaxially growing a second silicon layer over the first surface portion of the silicon substrate, said second silicon layer having a surface with a second crystal orientation; and
 - iv. forming a second buried oxide layer in the second silicon layer;
 - B. fabricating a first semiconductor device on an exposed surface of the first silicon layer; and
 - C. fabricating a second semiconductor device on the second silicon layer.
9. The method of claim 8 wherein the first semiconductor device is a P-MOSFET and the second semiconductor device is an N-MOSFET.
10. The method of claim 8 wherein the selectively removing step comprises the steps of:

providing a hard mask over the first silicon layer;
providing a photoresist pattern on the hard mask; and
etching portions of the first silicon layer and the buried oxide layer not covered by said photoresist, and removing said photoresist.

11. The method of claim 10 wherein said hard mask comprises Si_3N_4 .
12. The method of claim 8 wherein the step of forming the second buried oxide layer comprises the steps of implanting oxygen ions into the second silicon layer and annealing the SOI substrate.
13. The method of claim 8 wherein the first crystal orientation is a (110) orientation and the second crystal orientation is a (100) orientation.
14. The method of claim 9 wherein the first crystal orientation is a (110) orientation and the second crystal orientation is a (100) orientation.
15. The method of claim 8 wherein the first crystal orientation is a (100) orientation and the second crystal orientation is a (110) orientation.
16. A semiconductor device constructed in accordance with the method of claim 8.
17. An SOI substrate, comprising:
 - a silicon substrate having a surface with a first crystal orientation;
 - first and second buried oxide layers each extending over and in contact with different portions of the silicon substrate surface;
 - first and second silicon layers located over said first and second buried oxide layers, respectively, said first and second silicon layers having surfaces with different crystal orientations, one of said different orientations being said first crystal orientation.

18. The SOI substrate of claim 17 wherein the first crystal orientation is a (110) orientation and the second crystal orientation is a (100) orientation.

19. The SOI substrate of claim 17 wherein the first crystal orientation is a (100) orientation and the second crystal orientation is a (110) orientation.